

CLAIMS:

Sub
A1

1. A multi-query data visualization process comprising:
inputting a plurality of query objects into a data processing device;
identifying features within each of the plurality of query objects
that allow comparison to a body of data stored in a database;
determining relative relationships between each of the plurality of
query objects and the body of data; and
displaying points along a plurality of rays, wherein a position of
each of the displayed points corresponds to the determined relative
relationship between each respective one of the plurality of query objects
and the body of data.

2. The process of claim 1, wherein displaying includes placing
a small graphic entity at an end of each of the plurality of rays to
represent a respective one of the plurality of query objects.

3. The process of claim 1, wherein displaying includes locating
the plurality of rays to have a common origin.

4. The process of claim 3, wherein displaying includes locating
the plurality of rays to radiate outwardly from the common origin at
equally-spaced angles from one another.

0050101051017N

1 5. The process of claim 1, wherein displaying includes locating
2 the plurality of rays to have a common origin and further comprising
3 determining a critical distance from the common origin, wherein points
4 on the plurality of rays falling within the critical distance meet or exceed
5 a relevancy threshold and points on the plurality of rays outside the
6 critical distance do not meet the relevancy threshold.

7
8 6. The process of claim 5, further comprising adjusting the
9 critical distance in response to user input.

10
11 7. The process of claim 1, further comprising:
12 re-determining relative relationships between each of the plurality
13 of query objects and the body of data in response to user input; and
14 rearranging the positions of the displayed points in response to re-
15 determining.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

8. The process of claim 1, further comprising:
deleting an element from the body of data in response to user
input;
re-determining relative relationships between each of the plurality
of query objects and the body of data in response to deleting; and
rearranging the positions of the displayed points in response to re-
determining.

9. The process of claim 1, wherein determining comprises
accessing data corresponding to the occurrence of textual information
within a plurality of documents and displaying comprises depicting usage
of the textual information within the documents corresponding to portions
of the plurality of query objects.

10. The process of claim 1, wherein determining comprises:
organizing data in the database and the plurality of query objects
in an n-dimensional space; and

reducing a number n of dimensions in which the data in the
database and the plurality of query objects are organized to two
dimensions using a Sammon projection.

1 11. The process of claim 1, wherein identifying comprises
2 representing each of the plurality of query objects and each datum in
3 the body of data as an n-dimensional vector in an n-dimensional vector
4 space.

5
6 12. The process of claim 11, wherein determining comprises
7 calculating a similarity measure between each of the plurality of query
8 objects and each datum of the body of data using some portion of the
9 n-dimensional vectors.

10
11 13. The process of claim 12, wherein determining further
12 comprises:

13 reducing a number n of dimensions in which the body of data and
14 the query objects are represented to three or fewer dimensions using a
15 multi-dimensional scaling method, where the similarity measures between
16 each of the plurality of query objects and the body of data are weighted
17 more heavily than the similarity measures among data within the body
18 of data; and

19 wherein displaying comprises displaying points corresponding to the
20 plurality of query objects and points corresponding to the body of data
21 according to the three or fewer dimensions.
22
23

1 14. The process of claim 1, wherein displaying further comprises
2 displaying points corresponding to data from the database along each of
3 the plurality of rays in a two dimensional display, wherein positions of
4 the displayed points correspond to the relative relationships.

5
6 15. The process of claim 1, wherein determining comprises:
7 determining thematic boundaries within each element contained in
8 the database;

9 breaking elements into subelements at the determined thematic
10 boundaries;

11 determining relative relationships between each of the plurality of
12 query objects and the subelements; and

13 displaying points corresponding to the subelements along each of
14 the plurality of rays, wherein positions of the displayed points correspond
15 to the relative relationships.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

16. The process of claim 1, wherein determining comprises:
breaking elements into subelements;
determining relative relationships between each of the plurality of
query objects and the subelements; and
displaying points corresponding to the subelements along each of
the plurality of rays, wherein positions of the displayed points correspond
to the relative relationships.

17. A data visualization apparatus comprising:
an image device configured to provide a visual image; and
digital processing circuitry coupled with the image device and
configured to:
input a plurality of query objects;
identify features within each of the plurality of query objects
that allow comparison to a body of data stored in a database;
determine relative relationships between each of the plurality
of query objects and the body of data; and
control the image device to depict points corresponding to
data from the database along each of a plurality of rays, wherein
positions of the displayed points correspond to the relative
relationships.

18. The data visualization apparatus of claim 17, wherein the digital processing circuitry configured to display includes digital processing circuitry configured to display a small graphic entity at an end of each of the plurality of rays to represent a respective one of the plurality of query objects.

19. The data visualization apparatus of claim 17, wherein the digital processing circuitry configured to display includes digital processing circuitry configured to display the plurality of rays to have a common origin.

20. The data visualization apparatus of claim 19, wherein the digital processing circuitry configured to display includes digital processing circuitry configured to display the plurality of rays to radiate outwardly from the common origin at equally-spaced angles from one another.

21. The data visualization apparatus of claim 17, wherein the digital processing circuitry configured to display includes digital processing circuitry configured to display the plurality of rays to have a common origin and further comprising digital processing circuitry configured to determine a critical distance from the common origin, wherein points on the plurality of rays falling within the critical distance meet or exceed a relevancy threshold and points on the plurality of rays outside the critical distance do not meet the relevancy threshold.

22. The data visualization apparatus of claim 21, wherein the digital processing circuitry is further configured to adjust the critical distance in response to user input.

23. The data visualization apparatus of claim 17, wherein the digital processing circuitry is further configured to:

re-determine relative relationships between each of the plurality of query objects and the body of data in response to user input; and

control the image device to rearrange positions of the displayed points in response to the re-determined relationship.

1 24. The data visualization apparatus of claim 17, wherein the
2 digital processing circuitry is further configured to:

3 delete an element from the body of data in response to user
4 input;

5 re-determine relative relationships between each of the plurality of
6 query objects and the body of data in response to deleting; and

7 control the image device to rearrange the positions of the
8 displayed points in response to re-determining.

9
10 25. The data visualization apparatus of claim 17, wherein the
11 digital processing circuitry configured to determine comprises digital
12 processing circuitry configured to access data corresponding to the
13 occurrence of textual information within a plurality of documents and the
14 digital processing circuitry configured to control the image device
15 comprises digital processing circuitry configured to depict usage of the
16 textual information corresponding to portions of the query objects
17 appearing within the documents via the image device.
18
19
20
21
22
23

1 26. The data visualization apparatus of claim 17, wherein the
2 digital processing circuitry configured to determine comprises digital
3 processing circuitry configured to:

4 organize data in the database and the plurality of query objects in
5 an n-dimensional space; and

6 reduce a number n of dimensions in which the data in the
7 database and the plurality of query objects are organized to two
8 dimensions using a Sammon projection.

9
10 27. The data visualization apparatus of claim 17, wherein the
11 digital processing circuitry configured to identify comprises digital
12 processing circuitry configured to represent each of the plurality of query
13 objects and each datum in the body of data as an n-dimensional vector
14 in an n-dimensional vector space.

15
16 28. The data visualization apparatus of claim 27, wherein the
17 digital processing circuitry configured to determine comprises digital
18 processing circuitry configured to calculate a similarity measure between
19 each of the plurality of query objects and each datum of the body of
20 data using some portion of the n-dimensional vectors.

005504-01001

1 29. The data visualization apparatus of claim 28, wherein the
2 digital processing circuitry configured to determine further comprises
3 digital processing circuitry configured to:

4 reduce a number n of dimensions in which the body of data and
5 the query objects are represented to three or fewer dimensions using a
6 multi-dimensional scaling method, where the similarity measures between
7 each of the plurality of query objects and the body of data are weighted
8 more heavily than the similarity measures among data within the body
9 of data; and

10 wherein the digital processing circuitry configured to display
11 comprises digital processing circuitry configured to display points
12 corresponding to the plurality of query objects and points corresponding
13 to the body of data according to the three or fewer dimensions.

14
15 30. The data visualization apparatus of claim 17, wherein the
16 digital processing circuitry configured to control the image device
17 comprises digital processing circuitry configured to control the image
18 device to display points corresponding to data from the database along
19 each of the plurality of rays in two dimensions, wherein positions of the
20 displayed points correspond to the relative relationships.

1 31. The data visualization apparatus of claim 17, wherein the
2 digital processing circuitry configured to determine relative relationships
3 comprises digital processing circuitry configured to:

4 determine thematic boundaries within each element contained in the
5 database;

6 break elements into subelements at the determined thematic
7 boundaries; and

8 determine relative relationships between each of the plurality of
9 query objects and the subelements; and wherein the digital processing
10 circuitry configured to control the image device to display points
11 comprises digital processing circuitry configured to display points
12 corresponding to subelements along each of the plurality of rays, wherein
13 positions of the displayed points correspond to the relative relationships.

14
15
16
17
18
19
20
21
22
23

1 32. The data visualization apparatus of claim 17, wherein the
2 digital processing circuitry configured to determine relative relationships
3 comprises digital processing circuitry configured to:

4 break elements into subelements; and

5 determine relative relationships between each of the plurality of
6 query objects and the subelements; and wherein the digital processing
7 circuitry configured to control the image device to display points
8 comprises digital processing circuitry configured to display points
9 corresponding to subelements along each of the plurality of rays, wherein
10 positions of the displayed points correspond to the relative relationships.

11
12 33. A computer-readable medium comprising computer usable
13 code configured to cause digital processing circuitry to:

14 identify features of each of a plurality of query objects that allow
15 comparison to a body of data stored in a database;

16 determine relative relationships between each of the plurality of
17 query objects and the body of data; and

18 control an image device to depict points corresponding to data
19 from the database along each of a plurality of rays, wherein positions
20 of the displayed points correspond to the relative relationships.

34. The computer readable medium comprising computer usable code of claim 33, wherein the computer usable code configured to display includes computer usable code configured to display a small graphic entity at an end of each of the plurality of rays to represent a respective one of the plurality of query objects.

35. The computer readable medium comprising computer usable code of claim 33, wherein the computer usable code configured to display includes computer usable code configured to display the plurality of rays to have a common origin.

36. The computer readable medium comprising computer usable code of claim 35, wherein the computer usable code configured to display includes computer usable code configured to display the plurality of rays to radiate outwardly from the common origin at equally-spaced angles from one another.

1 40. The computer readable medium comprising computer usable
2 code of claim 39, wherein the computer usable code is further configured
3 to:

4 delete an element from the body of data in response to user
5 input;

6 re-determine relative relationships between each of the plurality of
7 query objects and the body of data in response to deleting; and

8 control the image device to rearrange the positions of the
9 displayed points in response to re-determining.

10
11 41. The computer readable medium comprising computer usable
12 code of claim 33, wherein the computer usable code configured to
13 determine comprises computer usable code configured to access data
14 corresponding to the occurrence of textual information within a plurality
15 of documents and the computer usable code configured to control the
16 image device comprises computer usable code configured to depict usage
17 of the textual information within the documents that correspond to
18 portions of the plurality of query objects.
19
20
21
22
23

1 42. The computer readable medium comprising computer usable
2 code of claim 33, wherein the computer usable code configured to
3 determine comprises computer usable code configured to:

4 organize data in the database and the plurality of query objects in
5 an n-dimensional space; and

6 reduce a number n of dimensions in which the data in the
7 database and the plurality of query objects are organized to two
8 dimensions using a Sammon projection.

9
10 43. The computer readable medium comprising computer usable
11 code of claim 33, wherein the computer usable code configured to
12 identify comprises computer usable code configured to represent each of
13 the plurality of query objects and each datum in the body of data as an
14 n-dimensional vector in an n-dimensional vector space.

15
16 44. The computer readable medium comprising computer usable
17 code of claim 43, wherein the computer usable code configured to
18 determine comprises computer usable code configured to calculate a
19 similarity measure between each of the plurality of query objects and
20 each datum of the body of data using some portion of the n-dimensional
21 vectors.

45. The computer readable medium comprising computer usable code of claim 44, wherein the computer usable code configured to determine further comprises computer usable code configured to:

reduce a number n of dimensions in which the body of data and the query objects are represented to three or fewer dimensions using a multi-dimensional scaling method, where the similarity measures between each of the plurality of query objects and the body of data are weighted more heavily than the similarity measures among data within the body of data; and

wherein the digital processing circuitry configured to display comprises digital processing circuitry configured to display points corresponding to the plurality of query objects and points corresponding to the body of data according to the three or fewer dimensions.

46. The computer readable medium comprising computer usable code of claim 33, wherein the computer usable code configured to control the image device comprises computer usable code configured to control the image device to display points corresponding to data from the database along each of the plurality of rays in two dimensions, wherein positions of the displayed points correspond to the relative relationships.

FOUO 10-2055460

1 47. The computer readable medium comprising computer usable
2 code of claim 33, wherein the computer usable code configured to
3 determine comprises computer usable code configured to:

4 determine thematic boundaries within each element contained in the
5 database;

6 break elements into subelements at the determined thematic
7 boundaries; and

8 determine relative relationships between each of the plurality of
9 query objects and the subelements; and wherein the computer usable
10 code configured to control the image device comprises computer usable
11 code configured to display points corresponding to subelements along
12 each of the plurality of rays, wherein positions of the displayed points
13 correspond to the relative relationships.

1 48. The computer readable medium comprising computer usable
2 code of claim 33, wherein the computer usable code configured to
3 determine comprises computer usable code configured to:

4 break elements into subelements; and

5 determine relative relationships between each of the plurality of
6 query objects and the subelements; and wherein the computer usable
7 code configured to control the image device comprises computer usable
8 code configured to display points corresponding to subelements along
9 each of the plurality of rays, wherein positions of the displayed points
10 correspond to the relative relationships.

11
12 49. A computer data signal embodied in a transmission medium
13 comprising computer usable code configured to:

14 input a plurality of query objects into a data processing device;

15 determine relative relationships between each of the plurality of
16 query objects and a body of data stored in a database; and

17 control an image device to depict points corresponding to data
18 from the database along each of a plurality of rays, wherein positions
19 of the displayed points correspond to the relative relationships.
20
21
22
23

1 50. The signal according to claim 49, wherein the computer
2 usable code configured to display includes computer usable code
3 configured to display a small graphic entity at an end of each of the
4 plurality of rays to represent a respective one of the plurality of query
5 objects.

6
7 51. The signal according to claim 49, wherein the computer
8 usable code configured to display includes computer usable code
9 configured to display the plurality of rays to have a common origin.

10
11 52. The signal according to claim 51, wherein the computer
12 usable code configured to display includes computer usable code
13 configured to display the plurality of rays as radiating outwardly from
14 the common origin at equally-spaced angles from one another.
15
16
17
18
19
20
21
22
23

53. The signal according to claim 49, wherein the computer usable code configured to display includes computer usable code configured to display the plurality of rays to have a common origin, and further comprising computer usable code configured to determine a critical distance from the common origin, wherein points on the plurality of rays falling within the critical distance meet or exceed a relevancy threshold and points on the plurality of rays outside the critical distance do not meet the relevancy threshold.

54. The signal according to claim 53, wherein the computer usable code is further configured to adjust the critical distance in response to user input.

55. The signal according to claim 49, wherein the computer usable code is further configured to:

re-determine relative relationships between each of the plurality of query objects and the body of data in response to user input; and control the image device to rearrange the positions of the displayed points in response to the re-determined relative relationships.

1 56. The signal according to claim 49, wherein the computer
2 usable code is further configured to:

3 delete an element from the body of data in response to user
4 input;

5 re-determine relative relationships between each of the plurality of
6 query objects and the body of data in response to deletion; and

7 control the image device to rearrange the positions of the
8 displayed points in response to re-determining.

9
10 57. The signal according to claim 49, wherein the computer
11 usable code configured to determine comprises computer usable code
12 configured to access data corresponding to the occurrence of textual
13 information within a plurality of documents and the computer usable
14 code configured to control the image device comprises computer usable
15 code configured to depict usage of the textual information within the
16 documents that correspond to portions of the plurality of query objects.
17
18
19
20
21
22
23

1 58. The signal according to claim 49, wherein the computer
2 usable code configured to determine comprises computer usable code
3 configured to:

4 organize data in the database and the plurality of query objects in
5 an n-dimensional space; and

6 reduce a number n of dimensions in which the data in the
7 database and the plurality of query objects are organized to two
8 dimensions using a Sammon projection.

9
10 59. The signal according to claim 49, wherein the computer
11 usable code configured to control the image device comprises computer
12 usable code configured to control the image device to display points
13 corresponding to data from the database along each of the plurality of
14 rays in two dimensions, wherein positions of the displayed points
15 correspond to the relative relationships.

1 60. The signal according to claim 49, wherein the computer
2 usable code configured to determine comprises computer usable code
3 configured to:

4 determine thematic boundaries within each document contained in
5 the database;

6 break documents into subdocuments at the determined thematic
7 boundaries; and

8 determine relative relationships between each of the plurality of
9 query objects and the subdocuments; and wherein the computer usable
10 code configured to control the image device comprises computer usable
11 code configured to display points corresponding to subdocuments along
12 each of the plurality of rays, wherein positions of the displayed points
13 correspond to the relative relationships.

10555260
FOUO

64. The signal according to claim 63, wherein the computer usable code configured to determine further comprises computer usable code configured to:

reduce a number n of dimensions in which the body of data and the query objects are represented to three or fewer dimensions using a multi-dimensional scaling method, where the similarity measures between each of the plurality of query objects and the body of data are weighted more heavily than the similarity measures among data within the body of data; and

wherein the digital processing circuitry configured to display comprises digital processing circuitry configured to display points corresponding to the plurality of query objects and points corresponding to the body of data according to the three or fewer dimensions.

65. A data visualization process comprising:

inputting a plurality of query objects into in a data processor;

determining relative relationships between each of the plurality of query objects and a body of data; and

displaying a point along each of a plurality of rays for each of the plurality of query objects, wherein positions of the displayed points correspond to the relative relationships between a respective one of the plurality of query objects and the body of data.

1 66. The data visualization process of claim 65, wherein displaying
2 includes placing a small graphic entity at an end of each of the plurality
3 of rays to represent a respective one of the plurality of query objects.
4

5 67. The data visualization process of claim 65, wherein
6 determining relative relationships comprises determining relative
7 relationships between each of the plurality of query objects and a body
8 of data stored in a database in the data processor.
9

10 68. The data visualization process of claim 65, further comprising
11 redetermining relative relationships in response to user input criteria.
12

13 69. The data visualization process of claim 65, wherein displaying
14 comprises displaying the plurality of rays to have a common origin.
15

16 70. The data visualization process of claim 65, wherein displaying
17 comprises displaying the plurality of rays to have a common origin and
18 to radiate outwardly from the common origin at equally-spaced angles
19 from one another.
20
21
22
23

71. The process of claim 69, further comprising determining a critical distance from the common origin, wherein points on the plurality of rays falling within the critical distance meet or exceed a relevancy threshold and points on the plurality of rays outside the critical distance do not meet the relevancy threshold.

TOP SECRET